THE BIOLOGY OF *PHANETA IMBRIDANA* (LEPIDOPTERA : TORTRICIDAE), A SEED PREDATOR OF *XANTHIUM STRUMARIUM* (COMPOSITAE)

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Of the more than sixty North American species of *Phaneta,* host plants are known for less than one third. All of the known hosts are in the family Compositae, and most species feed only on the flowers or seeds of their host plant (Heinrich, 1923, Mackay, 1959). (Host plants are listed by these authors for the species of the genus, *Thiodia,* the North American members of which have been transferred to *Phaneta* (Obraztsov, 1952)). Although *Phaneta imbridana* (Fernald) has been known to taxonomists for years (Fernald, 1905, Miller, 1970), nothing is known of its biology or life history. I therefore report certain aspects of the ecology of *P. imbridana* and its relationship with a local host plant, *Xanthium strumarium,* unique among the Compositae by having relatively large fruits and seeds. This information was obtained as part of a larger study of the variation in susceptibility of populations of *X. strumarium* to seed predation by more than one species of seed predator along Long Island beaches.

A. Life Cycle

Adults emerge in late August and can be found until late September, with oviposition occurring throughout the adult period. Females oviposit directly on the surface of the full-sized but immature burrs of *X. strumarium.* Eggs soon hatch and the larvae bore through the burr wall and begin to feed on one of two seeds of the burr. If one seed is insufficient for complete larval development, larvae will attack the other seed within the same burr, or rarely, seeds of another burr on the same plant. Full larval development is completed by late September or early October, at which

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Table 1

Distribution of *Phaneta imbridana* among Populations of *Xanthium strumarium*

Mean Proportion Seeds Attacked (1973–1975)

	Population Number									
	1	2	3	4	5	6	7	8	9	10
Upper Seed	.03	.12	.05	.09	.01	.05	.03	.07	.07	0.0
Lower Seed	.07	.20	.24	.20	.07	.15	.10	.22	.12	.05

time larvae leave the burr through a hole bored near its basal end. Since burrs reach full maturity and are easily dislodged and dispersed before larvae leave the burr, passive long-range dispersal of *P. imbridana* may occur in the larval stage.

Local populations of *P. imbridana* overwinter as last-instar larvae in the dry pithy stems of *X. strumarium*. It is unlikely that *P. imbridana* is limited to *X. strumarium* for overwintering, however, the other common herbaceous species associated with *X. strumarium* do not contain overwintering larvae. Pupation occurs in the stem fragments in the following summer. Mating behavior was not observed.

B. Role as a Seed Predator

Levels of seed predation were measured for ten populations of *X. strumarium* over a three-year period. Consistent, significant differences in the abundance of *P. imbridana* were observed among plant populations (Table 1), however, mean seed loss was less than 10%.

The two seeds within a burr of *X. strumarium* differ in size and germination requirements (e.g. Wareing and Foda, 1957). The lower seed is larger and germinates the spring following production, while the smaller, upper seed remains dormant for one year or more if its seed coat remains intact. *Phaneta imbridana* is more commonly found in the lower, non-dormant seed within a burr (p less than .001). Although one cannot exclude the possibility that larvae or ovipositing females may be choosing seeds on the basis of their dormancy properties, differential seed predation within burrs is best explained by burr asymmetry. Since the larger seed occupies more than half of the burr cavity, it is covered by more

than half of the burr surface, and oviposition is more likely to occur on burr surface adjacent to lower than to upper seeds.

C. Interactions with Other Seed Predators

The tephritid fly, *Euaresta aequalis* Loew, is another common seed predator of *X. strumarium*. The abundance of *E. aequalis* also varies significantly among populations, and larvae are more frequent in lower than upper seeds. The oviposition periods of both insect species coincide. Most local populations of *X. strumarium* are not attacked by both insect species, however, in those plant populations which experience at least 5% seed predation by both species, the abundance of the two species on individual plants is significantly negatively correlated ($r = -.42$, p less than .01). An oviposition experiment was performed using plants from several populations grown under uniform conditions and then simultaneously exposed to both insect species. The number of burrs attacked by both species was much less than expected assuming that their oviposition behaviors were independent (Table 2), and the number of burrs containing one larva of *P. imbridana* and one undamaged seed was much greater than expected.

These results indicate that within populations, some plants may produce burrs more susceptible to one insect species than the other,

Table 2

Frequency of Attack of Seeds Within Burrs

	Disposition					
	PP	UP	PE	EE	UE	UU
Observed	16	70	43	110	46	87
Expected	14.1	56.5	60.2	64.2	130.5	56.5
Difference	1.9	13.5	-17.2	45.8	-74.5	30.5

G-test Statistic = 110.024, p less than .005

PP = Both seeds containing *P. imbridana.*
UP = One seed containing *P. imbridana* and the other undamaged.
PE = One seed containing *P. imbridana* and the other containing *E. aequalis.*
EE = Both seeds containing *E. aequalis.*
UE = One seed containing *E. aequalis* and the other undamaged.
UU = Both seeds undamaged.

and also that within plants, *P. imbridana* may avoid ovipositing on burrs previously attacked by others of its own or different species. Further investigations are in progress to determine which particular aspects of burr morphology and chemistry most strongly influence susceptibility of burrs to each insect species.

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